

SPECIFICATION

TITLE OF THE INVENTION: FILTER PRODUCTION METHOD

TECHNICAL FIELD

5 [0001] The present disclosure relates to a filter production method.

The present application claims priority based on Japanese Patent Application No. 2020-031974 filed February 27, 2020, the entire content of which is incorporated herein by reference.

BACKGROUND ART

10 [0002] Patent Document 1 discloses a method for producing a porous membrane or tape of expanded polytetrafluoroethylene (hereinafter referred to as “PTFE”) loading catalyst particles. In this method for producing an expanded PTFE porous film or tape, the average particle size of the catalyst particles in the dispersion is significantly smaller than the average pore size of the impregnated tape-like porous PTFE and is preferably within the range of 0.001 to 0.1 μm .
15 Further, the catalyst concentration in the catalyst dispersion or solution is preferably adjusted as desired within the range of 0.1 to 10 wt% so that the tape-like porous PTFE is impregnated with the catalyst in an amount 10 times the desired amount of the catalyst to be loaded.

[0003] Patent Document 2 discloses a method for producing a chemically reactive substrate, including the steps of mixing a PTFE dispersion and catalyst particles to form a slurry, drying
20 the slurry to form a powder and forming paste from the powder, and forming an element from the paste and heating and expanding the element into a porous expanded PTFE matrix having polymeric nodes.

Citation List

25 Patent Literature

[0004]

Patent Document 1: JP5455407B

Patent Document 2: JPH11-505469A (translation of a PCT application)

SUMMARY

Problems to be Solved

[0005] However, the method for producing an expanded PTFE porous membrane or tape disclosed in Patent Document 1 not only requires a large pulverization power to form fine catalyst particles, but also needs to adjust the catalyst particle size in accordance with the average pore size of PTFE. The preparation of the catalyst powder requires a great deal of energy and is expensive, and the stretching causes a catalyst loading distribution, reducing the contact efficiency between the exhaust gas and the catalyst. Further, since the applicable catalyst concentration is only in the range of 0.1 to 10 wt%, several impregnation steps are required to increase the catalyst loading amount, increasing the production cost and the production time. Furthermore, since the catalyst is loaded by impregnation, it is necessary to impregnate the entire tape-like porous PTFE with the catalyst slurry, which increases the amount of catalyst powder and solvent to be disposed of.

[0006] Meanwhile, in the method for producing a chemically reactive substrate disclosed in Patent Document 2, catalyst particles contained in the element (paste) to be heated and expanded may degrade the element, resulting in poor expansion properties. Further, when the element (paste) containing catalyst particles is stretched and expanded, it is not possible to achieve a high draw ratio. Especially when the element (paste) degrades, the draw ratio decreases, and the strength of the porous matrix becomes insufficient.

[0007] The present disclosure was made in view of the above problems, and an object thereof is to provide a filter production method that can produce a filter using a PTFE-based material such as Teflon (registered trademark) as a filter medium at low cost, with high gas contact efficiency.

Solution to the Problems

[0008] To achieve the above object, a method for producing a filter according to at least one embodiment includes: a relation derivation step of deriving, for each filter medium, a

relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium; a concentration determination step of determining a concentration of the organic solvent from a target loading amount to be loaded on the filter medium on the basis of the relation derived in the relation derivation step; a slurry production step of producing the catalyst slurry containing the organic solvent at a concentration that is equal to or higher than the concentration determined in the concentration determination step; and a slurry application step of applying the catalyst slurry produced in the slurry production step to the filter medium.

Advantageous Effects

[0009] With the filter production method according to at least one embodiment, since the relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium is derived for each filter medium, a filter using a filter medium containing a water-repellent material, for example, a PTFE-based material such as Teflon, can be produced at low cost. Further, since the catalyst can be uniformly applied onto the filter medium, high gas contact efficiency can be achieved.

BRIEF DESCRIPTION OF DRAWINGS

[0010] FIG. 1 is a flowchart schematically showing a filter production method according to an embodiment.

FIG. 2 is a diagram showing an example of the relation derived in the relation derivation step shown in FIG. 1.

FIG. 3A is a diagram showing a relation between organic solvent concentration and denitration reaction rate constant ratio.

FIG. 3B is a diagram showing the denitration reaction rate constant ratio of filters of Sample 1, Sample 2, and Sample 3.

FIG. 4A is a diagram showing a surface image when the catalyst slurry is applied to the filter medium in the process of producing the filter of Sample 1.

FIG. 4B is a diagram showing a surface image when the catalyst slurry is applied to the filter medium in the process of producing the filter of Sample 2.

5 FIG. 4C is a diagram showing a surface image when the catalyst slurry is applied to the filter medium in the process of producing the filter of Sample 3.

DETAILED DESCRIPTION

[0011] A filter production method according to some embodiments will now be described
10 with reference to the accompanying drawings. It is intended, however, that unless particularly identified, dimensions, materials, shapes, relative positions, and the like of components described in the embodiments shall be interpreted as illustrative only and not intended to limit the scope of the present invention.

[0012] The filter described here is, for example, a filter also called a bag filter, and is used
15 in, for example, an exhaust gas treatment device for a coal-fired boiler, an exhaust gas treatment device for an oil-fired boiler, an exhaust gas treatment device for a general waste treatment plant, an exhaust gas treatment device for an industrial waste incinerator plant (including desulfurization device, denitration device, or dust removal device), or a dust removal device for exhaust gas including soot and dust of a cement plant or a steel plant. This filter can also be
20 used for a HEPA filter as a dust removal function of an exhaust gas purification system of a gas turbine or another toxic gas treatment system.

[0013] The filter described here is a catalytic filter in which a catalyst (e.g., denitration catalyst, oxidation catalyst, dioxins decomposition catalyst (DXNs decomposition catalyst), etc.) is supported on a filter medium (e.g., filter cloth). The catalytic filter is manufactured by
25 uniformly applying a catalyst slurry obtained by adding a catalyst to water to the surface of a filter medium (filter cloth). Although a glass material has been mainly used for the filter medium, a material containing a PTFE-based material such as Teflon is used for the filter medium described here. Since the material containing a PTFE-based material has water

repellency, the catalyst slurry described here is made by adding a catalyst to an organic solvent/water system.

[0014] FIG. 1 is a flowchart schematically showing a filter production method according to an embodiment.

5 As shown in FIG. 1, the filter production method according to an embodiment includes a relation derivation step (S11), a concentration determination step (S12), a slurry production step (S13), and a slurry application step (S14).

[0015] In the relation derivation step (S11), a relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of
10 a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium is derived for each filter medium.

[0016] As the catalyst slurry, slurry obtained by adding a catalyst to an organic solvent/water system is used as described above. Examples of the catalyst include a denitration catalyst, an oxidation catalyst, and a dioxins decomposition catalyst (DXNs
15 decomposition catalyst), as described above. Examples of the organic solvent in the organic solvent/water system include methanol, ethanol, propanol, butanol, ethylene glycol, formaldehyde, acetaldehyde, acetone, methyl ethyl ketone, formic acid, and acetic acid. The organic solvent in the organic solvent/water system is not limited to one solvent, but may be a mixture of two or more types of solvents. As the filter medium, for example, a material
20 containing a PTFE-based material such as Teflon is used, as described above.

[0017] FIG. 2 is a diagram showing an example of the relation derived in the relation derivation step (S11) shown in FIG. 1. In the example shown in FIG. 2, the organic solvent in the organic solvent/water system is ethanol, and the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry is 0 wt%, 5 wt%, 10 wt%, 20
25 wt%, 30 wt%, or 40 wt%. The concentration of the catalyst in the catalyst slurry is, for example, 25 wt%, but there is no need to limit the catalyst concentration thereto or to keep the catalyst concentration constant. The unit of the loading amount of the catalyst when the catalyst slurry is applied to the filter medium is g/m^2 . The difference in the filter medium may

be regarded as, for example, the difference in the content rate of the PTFE-based material in the material of the filter medium or the difference in the shape of the filter medium fiber, but in this relation, the filter medium is specified by a tilting angle (referred to as “roll-off angle” or “sliding angle”) of a solid sample at which a liquid dripped onto the solid sample begins to slide when the liquid — in the present embodiment, water (deionized water) — is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted.

[0018] In the example shown in FIG. 2, for example, 110 g/m^2 of catalyst is loaded on the filter medium by applying the catalyst slurry having a concentration of the organic solvent in the organic solvent/water system of 20 wt% only once to the filter medium specified by a roll-off angle of 14 degrees.

[0019] In the concentration determination step (S12), a concentration of the organic solvent is determined from a target loading amount to be loaded on the filter medium on the basis of the relation derived in the relation derivation step (S11). The target loading amount is the amount of the catalyst loaded on the filter medium by applying the catalyst slurry once. Therefore, for example, when the amount of the catalyst loaded on the filter medium by applying the catalyst slurry once is 110 g/m^2 , the target loading amount is 110 g/m^2 .

[0020] In the example shown in FIG. 2, for example, as to the filter medium specified by a roll-off angle of 14 degrees, when the target loading amount is 110 g/m^2 , the concentration of the organic solvent is determined to be 20 wt%.

[0021] The relationship “ $Y=A \times \sin X$ ” is established between the catalyst loading amount Y [g/m^2] and the roll-off angle (sliding angle) X [$^\circ$]. Here, the concentration of the organic solvent can be calculated by determining A ($A = F(Z)$, where Z is the concentration of the organic solvent (wt%)) that results in target loading amount $Y1$ [g/m^2] at roll-off angle $X1$ [$^\circ$].

[0022] In the slurry production step (S13), the catalyst slurry containing the organic solvent at a concentration that is equal to or higher than the concentration determined in the concentration determination step (S12) is produced. For example, the catalyst slurry containing the organic solvent at a concentration that is equal to or higher than that determined in the concentration determination step (S12) may be produced by mixing the organic solvent,

the catalyst, and water.

[0023] In the example shown in FIG. 2, in order to load the catalyst on the filter medium specified by a roll-off angle of 14 degrees at a loading amount (target loading amount) of 110 g/m², the catalyst slurry having a concentration of the organic solvent of 20 wt% or higher is produced. Thus, the concentration of the organic solvent in the catalyst slurry produced in the slurry production step (S13) may be 30 wt% or 40 wt% as long as it is 20 wt% or higher. The reason why the concentration of the organic solvent is set to 20 wt% or higher is that a concentration of 20 wt% or higher will enable the loading of more than the target loading amount of catalyst.

[0024] In the slurry application step (S14), the catalyst slurry produced in the slurry production step (S13) is applied to the filter medium. The catalyst slurry may be applied by spraying the catalyst slurry to the filter medium by a spray nozzle, or by immersing the filter medium in the catalyst slurry.

[0025] The adhesive energy E of the catalyst slurry adhering to the filter medium by applying the catalyst slurry to the filter medium (filter cloth) can be expressed by the following equation 1.

[0026] (Equation 1)

$$E = \frac{m g \sin X}{2 \pi r}$$

E: Adhesive energy

r: Contact radius

m: Mass of droplet

g: Gravitational acceleration

X: Roll-off angle (Sliding angle)

[0027] With the filter production method according to the above-described embodiment, since the relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium is derived for each filter medium,

the concentration of the organic solvent in the organic solvent/water system can be appropriately set, so that a filter using a filter medium containing a water-repellent material, for example, a PTFE-based material such as Teflon, can be produced at low cost. Further, since the catalyst can be uniformly applied to the filter medium, high gas contact efficiency can be achieved.

[0028] In the filter production method according to an embodiment, the surface tension of the organic solvent in the organic solvent/water system is 50 mN/m or less. The organic solvent having a surface tension of 50 mN/m or less may be, for example, methanol, ethanol, propanol, butanol, ethylene glycol, formaldehyde, acetaldehyde, acetone, methyl ethyl ketone, formic acid, or acetic acid. The surface tension of methanol is 22.6 mN/m, and the surface tension of ethanol is 22.6 mN/m. The surface tension of propanol is 23.7 mN/m, and the surface tension of butanol is 25.4 mN/m. The surface tension of ethylene glycol is 48.4 mN/m, the surface tension of formaldehyde is 27.4 mN/m, and the surface tension of acetaldehyde is 21.2 mN/m. The surface tension of acetone is 23.3 mN/m, and the surface tension of methyl ethyl ketone is 24.6 mN/m. The surface tension of formic acid is 37.7 mN/m, and the surface tension of acetic acid is 27.7 mN/m. The surface tensions of these organic solvents are significantly smaller than the surface tension of water, and these organic solvents are expected to have an affinity for water.

[0029] In the slurry application step (S14) of the filter production method according to an embodiment, the catalyst slurry is sprayed to the filter medium by a spray nozzle (hereinafter, spraying the catalyst slurry to the filter medium by a spray nozzle is referred to as "spraying").

[0030] With this method, the amount of the catalyst slurry is less than when the catalyst slurry is applied to the filter medium by immersing the filter medium into the catalyst slurry, so that the cost associated with disposal of the catalyst slurry or the like can be reduced compared to the case where the catalyst slurry is applied to the filter medium by immersing the filter medium into the catalyst slurry.

[0031] FIG. 3A is a diagram showing a relation between organic solvent concentration and denitration reaction rate constant ratio. FIG. 3B is a diagram showing the denitration reaction

rate constant ratio of filters of Sample 1, Sample 2, and Sample 3. The filters of Sample 1, Sample 2, and Sample 3 are obtained by applying catalyst slurries of different organic solvent concentrations to filter media of the same type. The filter medium is a material (PTFE) specified by a roll-off angle of 14 degrees. The catalyst contained in the catalyst slurry is a denitration reaction catalyst (V-Ti-based denitration catalyst), and the solvent of the catalyst slurry is a mixed solvent of ethanol and water. The catalyst is applied to the filter medium by a spray nozzle. The spray pressure of the spray nozzle is 0.01 to 0.2 MPa. The loading amount (target loading amount) of the catalyst to be loaded on the filter medium is 110 g/m².

[0032] The concentration of the organic solvent contained in the catalyst slurry applied to the filter medium in the process of producing the filter of Sample 1 is 20 wt%, which can complete the filter by one application (see FIG. 2). Thus, the filter of Sample 1 is produced by applying the catalyst slurry to the filter medium once, and the catalyst of the target loading amount (110 g/m²) is loaded on Sample 1. The concentrations of the organic solvents contained in the catalyst slurries applied to the filter media in the process of producing the filters of Sample 2 and Sample 3 are 10 wt% and 5 wt%, respectively, which cannot complete the filters by one application (see FIG. 2). Thus, the filters of Sample 2 and Sample 3 are produced by applying the catalyst slurries to the filter media twice, and the catalyst greatly exceeding the target loading amount is loaded on Sample 2.

[0033] As shown in FIG. 3, when the denitration reaction rate constant ratio of the filter of Sample 1 is 1.00, the denitration reaction rate constant ratio of the filter of Sample 2 is 0.86, and the denitration reaction rate constant ratio of the filter of Sample 3 is 0.73. Therefore, the denitration reaction performance of the filter of Sample 1 is 1.37 times (1.00/0.73) of the filter of Sample 3. According to this, the filter of Sample 1 has better denitration reaction performance than the filter of Sample 2, even though it has a lower catalyst loading than the filter of Sample 3.

[0034] FIG. 4A is a diagram showing a surface image when the catalyst slurry is applied to the filter medium in the process of producing the filter of Sample 1. FIG. 4B is a diagram showing a surface image when the catalyst slurry is applied to the filter medium in the process

of producing the filter of Sample 2 (after one application). FIG. 4C is a diagram showing a surface image when the catalyst slurry is applied to the filter medium in the process of producing the filter of Sample 3 (after one application). As shown in FIG. 4A, the catalyst slurry is evenly dispersed in the filter of Sample 1. Therefore, it is considered that the catalyst is evenly loaded on the filter medium. On the other hand, as shown in FIGs. 4B and 4C, the catalyst slurry is aggregated in the filters of Samples 2 and 3. Therefore, it is considered that the catalyst is not evenly loaded on the filter medium. Thus, in the process of producing the filter, the concentration of the organic solvent that allows the filter to be completed by applying the catalyst slurry to the filter medium once is superior to the concentration of the organic solvent that requires the catalyst slurry to be applied to the filter medium multiple times because the former allows the catalyst slurry to be loaded evenly, resulting in larger gas contact area and excellent denitration reaction performance.

[0035] In view of the above, in the filter production method according to an embodiment, the target loading amount is a finished loading amount at the completion of the filter, and the number of times the catalyst slurry is applied in the slurry application step is once.

[0036] With this method, the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry is appropriate for the catalyst loading amount, and the catalyst can be evenly loaded on the filter medium (filter cloth) by applying the catalyst slurry once. Further, since the catalyst slurry needs to be applied only once, the filter with excellent performance can be produced at low cost.

[0037] Further, since the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry is appropriate, the cost of wastewater and exhaust treatment facility required for treating the organic solvent can be reduced.

[0038] Further, since the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry is appropriate, and the catalyst can be evenly loaded on the filter medium (filter cloth) by applying the catalyst slurry once, the differential pressure of the filter is reduced, and the catalyst can be effectively used for the reaction.

[0039] In addition, the reduction in the differential pressure of the filter enables a reduction

in the power of the dust collector blower using the filter, a reduction in the number of backwashes, and an extension of the lifetime of the filter.

[0040] In the filter production method according to another embodiment, the target loading amount is less than a finished loading amount at the completion of the filter, and the number of times the catalyst slurry is applied in the slurry application step is at least two or more times. The target loading amount may be half or less the finished loading amount at the completion of the filter, and the number of times the catalyst slurry is applied in the slurry application step may be two or more times. In this case, the organic solvent contained in the catalyst slurry applied for the first time and the organic solvent contained in the catalyst slurry applied for the second and subsequent times do not have to be of the same components. Further, the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry applied for the first time and the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry applied for the second and subsequent times do not have to be the same concentration.

[0041] With this method, the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry can be reduced as compared with the case where the catalyst slurry is applied once, so that the cost of disposing of the catalyst slurry or the like can be reduced as compared with the case where the catalyst slurry is applied once.

[0042] The present invention is not limited to the embodiments described above, but includes modifications to the embodiments described above, and embodiments composed of combinations of those embodiments.

[0043] For example, the filter medium used may be specified by a tilting angle of a solid sample of 5° or more and 25° or less at which a water droplet on the solid sample begins to slide when 120 μ l of a liquid is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted. Further, the catalyst is loaded on the filter medium at 100 g/m² on the basis of a relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium.

[0044] The contents described in the above embodiments would be understood as follows, for instance.

[0045] (1) A filter production method according to one aspect includes: a relation derivation step (S11) of deriving, for each filter medium, a relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium; a concentration determination step (S12) of determining a concentration of the organic solvent from a target loading amount to be loaded on the filter medium on the basis of the relation derived in the relation derivation step (S11); a slurry production step (S13) of producing the catalyst slurry containing the organic solvent at a concentration that is equal to or higher than the concentration determined in the concentration determination step (S12); and a slurry application step (S14) of applying the catalyst slurry produced in the slurry production step (S13) to the filter medium.

[0046] With this production method, since the relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium is derived for each filter medium, the concentration of the organic solvent in the organic solvent/water system can be appropriately set, so that a filter using a filter medium containing a water-repellent material, for example, a PTFE-based material such as Teflon, can be produced at low cost.

[0047] (2) A filter production method according to another aspect is the filter production method described in (1), in which the surface tension of the organic solvent is 50 mN/m or less.

[0048] With this production method, since the surface tension is 50 mN/m or less, it is significantly smaller than the surface tension of water and is expected to have an affinity for water.

[0049] (3) A filter production method according to still another aspect is the filter production method described in (1) or (2), in which the target loading amount is a finished loading amount at the completion of the filter, and the number of times the catalyst slurry is

applied in the slurry application step (S14) is once.

[0050] With this production method, the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry is appropriate for the catalyst loading amount, and the catalyst can be evenly loaded on the filter medium (filter cloth) by applying the catalyst slurry once. Further, since the catalyst slurry needs to be applied only once, the filter with excellent performance can be produced at low cost.

[0051] (4) A filter production method according to still another aspect is the filter production method described in (1) or (2), in which the target loading amount is less than a finished loading amount at the completion of the filter, and the number of times the catalyst slurry is applied in the slurry application step (S14) is at least two or more times.

[0052] With this production method, the concentration of the organic solvent contained in the catalyst slurry can be reduced as compared with the case where the catalyst slurry is applied once, so that the cost of disposing of the catalyst slurry or the like can be reduced as compared with the case where the catalyst slurry is applied once.

[0053] (5) A filter production method according to still another aspect is the filter production method described in any one of (1) to (4), in which the slurry application step (S14) includes spraying the catalyst slurry to the filter medium by a spray nozzle.

[0054] With this production method, the amount of the catalyst slurry is less than when the catalyst slurry is applied to the filter medium by immersing the filter medium into the catalyst slurry, so that the cost associated with disposal of the catalyst slurry or the like can be reduced compared to the case where the catalyst slurry is applied to the filter medium by immersing the filter medium into the catalyst slurry.

[0055] (6) A filter production method according to still another aspect is the filter production method described in any one of (1) to (5), in which in the relation, the filter medium is specified by a tilting angle of a solid sample at which a liquid dripped onto the solid sample begins to slide when the liquid is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted.

[0056] With this production method, the filter medium is specified by the water repellency

of the filter medium, and the concentration of the organic solvent contained in the catalyst slurry and the loading amount of the catalyst loaded on the filter medium when the catalyst slurry is applied can be adapted to the water repellency of the filter medium.

[0057] (7) A filter according to one aspect includes a filter medium specified by a tilting angle of a solid sample at which a liquid dripped onto the solid sample begins to slide when the liquid is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted. The concentration of the organic solvent is determined from the target loading amount to be loaded on the filter medium on the basis of a relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium.

[0058] With this configuration, the filter medium is specified by the water repellency of the filter medium, and the concentration of the organic solvent contained in the catalyst slurry and the loading amount of the catalyst loaded on the filter medium when the catalyst slurry is applied can be adapted to the water repellency of the filter medium. Further, since the concentration of the organic solvent in the organic solvent/water system contained in the catalyst slurry can be appropriately set, the filter medium containing a water-repellent material, for example, a Teflon-based material such as PTFE, can be adopted with the catalyst slurry evenly loaded, and the filter having with large gas contact area and excellent denitration reaction performance can be produced at low cost.

[0059] (8) A filter according to another aspect includes: a filter medium specified by a tilting angle of a solid sample of 5° or more and 25° or less at which a water droplet on the solid sample begins to slide when 120 μl of the liquid is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted; and a catalyst loaded on the filter medium at 100 g/m^2 on the basis of a relation between concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium.

[0060] With this configuration, high gas contact efficiency can be achieved.

[0061] (9) A filter according to still another aspect is the filter described in (8), in which

the surface tension of the organic solvent is 50 mN/m or less.

[0062] With this configuration, since the surface tension of the organic solvent is 50 mN/m or less, it is significantly smaller than the surface tension of water and is expected to have an affinity for water.

- 5 [0063] (10) A filter according to still another aspect is the filter described in (8), in which the organic solvent is ethanol.

[0064] With this configuration, since the organic solvent is ethanol, the filter can be inexpensive as compared with the case where another organic solvent is used.

10 Reference Signs List

[0065]

S11 Relation derivation step

S12 Concentration determination step

S13 Slurry production step

15 S14 Slurry application step

CLAIMS

1. A method for producing a filter, comprising:

a relation derivation step of deriving, for each filter medium, a relation between
5 concentration of an organic solvent in an organic solvent/water system contained in a catalyst
slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is
applied to the filter medium;

a concentration determination step of determining a concentration of the organic solvent
from a target loading amount to be loaded on the filter medium on the basis of the relation
10 derived in the relation derivation step;

a slurry production step of producing the catalyst slurry containing the organic solvent at
a concentration that is equal to or higher than the concentration determined in the concentration
determination step; and

a slurry application step of applying the catalyst slurry produced in the slurry production
15 step to the filter medium.

2. The method for producing a filter according to claim 1,
wherein a surface tension of the organic solvent is 50 mN/m or less.

3. The method for producing a filter according to claim 1 or 2,
20 wherein the target loading amount is a finished loading amount at the completion of the
filter, and the number of times the catalyst slurry is applied in the slurry application step is once.

4. The method for producing a filter according to claim 1 or 2,
25 wherein the target loading amount is less than a finished loading amount at the completion
of the filter, and the number of times the catalyst slurry is applied in the slurry application step
is at least two or more times.

5. The method for producing a filter according to any one of claims 1 to 4,
wherein the slurry application step includes spraying the catalyst slurry to the filter medium by a spray nozzle.

5 6. The method for producing a filter according to any one of claims 1 to 5,
wherein, in the relation, the filter medium is specified by a tilting angle of a solid sample at which a liquid dripped onto the solid sample begins to slide when the liquid is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted.

10 7. A filter, comprising
a filter medium specified by a tilting angle of a solid sample of 5° or more and 25° or less at which a water droplet on the solid sample begins to slide when 120 μl of the water droplet is dripped onto the solid sample placed horizontally and the solid sample is gradually tilted; and
a catalyst loaded on the filter medium at 100 g/m^2 on the basis of a relation between
15 concentration of an organic solvent in an organic solvent/water system contained in a catalyst slurry and loading amount of a catalyst loaded on the filter medium when the catalyst slurry is applied to the filter medium.

8. The filter according to claim 7,
20 wherein a surface tension of the organic solvent is 50 mN/m or less.

9. The filter according to claim 7,
wherein the organic solvent is ethanol.